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Yellowtail Reservoir, Bighorn County, Wyoming, and Bighorn and Carbon Counties, Montana

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

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NATIONAL EUTROPHICATION SURVEY

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT

ON

YELLOWTAIL RESERVOIR

BIGHORN COUNTY, WYOMING,

AND

BIGHORN AND CARBON COUNTIES, MONTANA

EPA REGION VIII

WORKING PAPER No. 894

WITH THE COOPERATION OF THE

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY,

THE MONTANA DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES,

AND THE

WYOMING AND MONTANA NATIONAL GUARD

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wyoming Department of Environmental Quality and the Montana Department of Health and Environmental Sciences for professional involvement, to the Wyoming and Montana National Guards for conducting the tributary sampling phase of the Survey, and to the Wyoming wastewater treatment plant operators who voluntarily provided effluent samples.

The staffs of the Wyoming Water Quality Division and the Montana Water Quality Bureau provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary report, and provided critiques most useful in the preparation of this Working Paper.

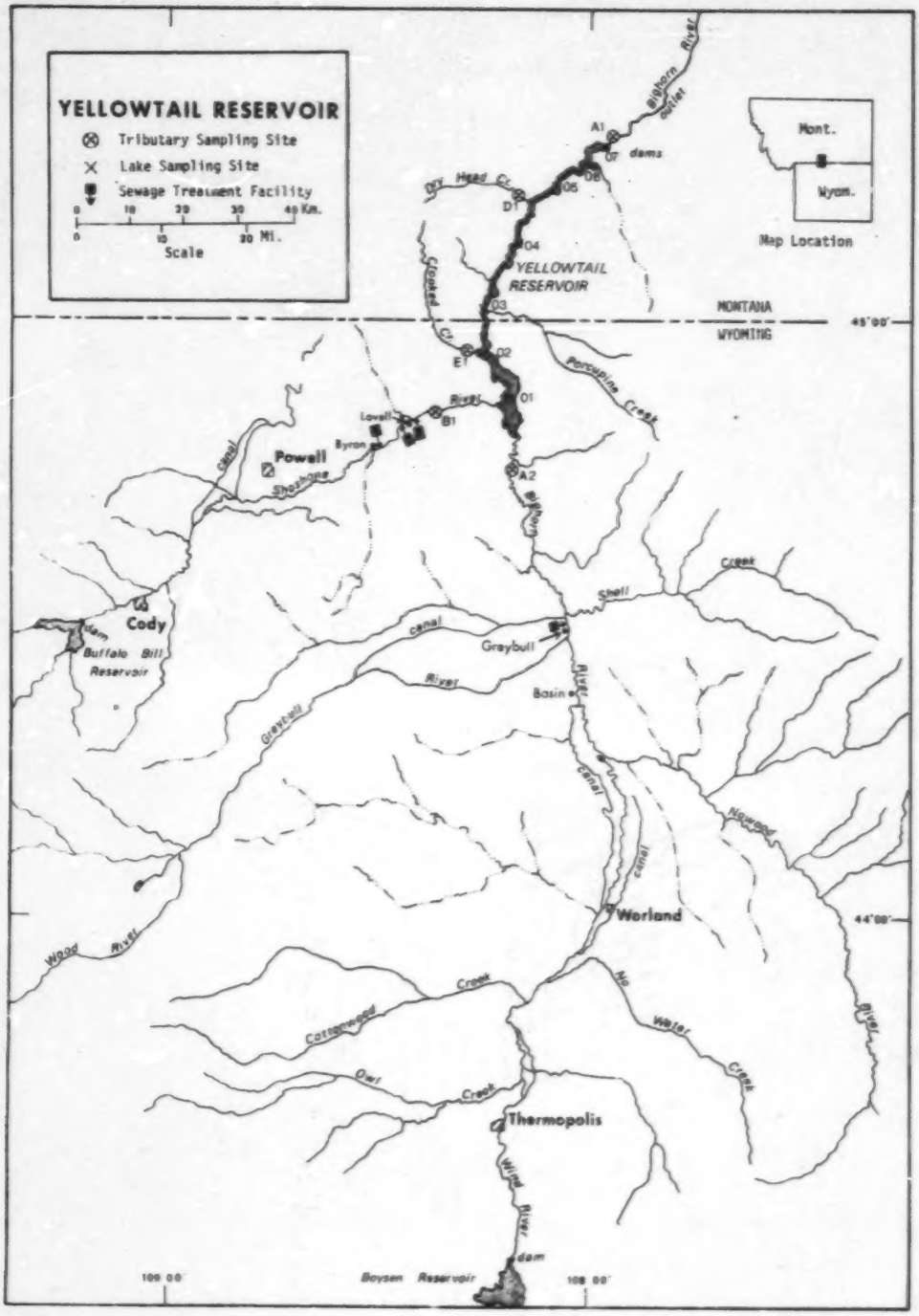
Brigadier General James L. Spence, the Adjutant General of Wyoming; Major General John J. Womack, the Adjutant General of Montana; and Project Officers Colonel Donald L. Boyer and Major William Yeager, who respectively directed the volunteer efforts of the Wyoming and Montana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of Wyoming

NAME	COUNTY
Big Sandy	Sublette, Sweetwater
Boulder	Sublette
Boysen	Fremont
De Smet	Johnson
Flaming Gorge	Sweetwater, WY; Daggett, UT
Fremont	Sublette
Glendo	Converse, Platte
Keyhole	Crook
Ocean	Fremont
Seminoe	Carbon
Soda	Sublette
Viva Naughton	Lincoln
Woodruff Narrows	Uinta
Yellowtail	Bighorn, WY; Bighorn, Carbon, MT


YELLOWTAIL RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 10 20 30 40 Km.
0 10 20 Mi.
Scale
Bighorn River
outlet
A1
07 dams
Dry Head Cr.
D6
D5
D1
D4
YELLOWTAIL
RESERVOIR
D3
Crooked Cr.
E1
D2
MONTANA
WYOMING
45°00'
Porcupine Creek
Lovell
B1
Byron
Powell
Shoshone
canal
D1
A2
Bighorn
Shell
Creek
Cody
dam
Buffalo Bill
Reservoir
canal
Greybull
River
Basin
Greybull
River
Worland
canal
Wood River
Creek
Corral
Owl
Creek
Thermopolis
Wind River
dam
Boysen Reservoir
108 00'
Mont.
Wyom.
Map Location
44°00'
No Water Creek
Nowood
River

YELLOWTAIL RESERVOIR

STORET NO. 5614

I. CONCLUSIONS

A. Trophic Condition:

Yellowtail Reservoir ranked seventh in overall trophic quality among the 14 Wyoming lakes and reservoirs sampled in 1975 using a combination of six water quality parameters*. However, Survey data indicate this long water body (98 km) is mesotrophic at stations 6 and 7; meso-eutrophic at station 5; and eutrophic at stations 1, 2, 3, and 4.

At mesotrophic stations 6 and 7, spring and fall mean total phosphorus ranged from 14 to 41 µg/l; spring and fall mean orthophosphorus ranged from 6 to 31 µg/l; mean inorganic nitrogen ranged from 240 to 600 µg/l; mean chlorophyll *a* ranged from 1.6 to 2.7 µg/l; and mean Secchi disc transparency ranged from 2.4 to 15.2 meters.

At meso-eutrophic station 5, spring and fall mean total phosphorus ranged from 24 to 116 µg/l; mean orthophosphorus ranged from 16 to 28 µg/l; mean inorganic nitrogen ranged from 280 to 810 µg/l; chlorophyll *a* ranged from 1.3 to 4.4 µg/l; and Secchi disc transparency ranged from 1.5 to 6.1 meters.

At eutrophic stations 1, 2, 3, and 4, spring and fall mean total phosphorus ranged from 19 to 950 µg/l; mean orthophosphorus ranged from 8 to 45 µg/l; mean inorganic nitrogen ranged from

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* See Appendix A.

260 to 670 µg/l; mean chlorophyll a ranged from 1.6 to 41.8 µg/l; and mean Secchi disc transparency ranged from 0.2 to 6.1 meters. No significant depression of dissolved oxygen occurred at any of the sampling stations or times.

In a previous study, it was noted that a 60-fold increase in turbidity and associated nitrate nitrogen and orthophosphate occurred from the dam to the upper end of the reservoir; and phytoplankton volumes also were noted to have increased similarly (Wright and Soltero, 1973; Soltero, Wright, and Horpestad, 1973).

B. Rate-Limiting Nutrient:

The algal assay results indicate Yellowtail Reservoir was phosphorus limited at the time the sample was collected (10/17/75). The reservoir data indicate phosphorus limitation at all sampling stations and times, with the exception of stations 4 and 5 in August.

C. Nutrient Controllability:

1. Point sources--The listed point sources accounted for 0.8% of the total phosphorus input to the reservoir during the sampling year. The wastewater treatment plants at Lovell, Byron, and Greybull contributed 0.3%, 0.2%, and 0.1% of the total, respectively. The Great Western Sugar Company at Lovell contributed 0.2%. In addition, municipal wastewater facilities of unknown significance

at Powell, Cody, Worland and Thermopolis discharge well upstream in the Shoshone and Wind-Bighorn river drainages. Further investigation is needed to determine the nutrient contributions of those sources.

The present phosphorus loading of 20.42 g/m^2/year is nearly 14 times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 15). Phosphorus loadings of 33.40 g/m^2/year and 15.23 g/m^2/year derived from 1968 and 1969 phosphorus and flow data reported by Wright and Soltero (1973) support Survey findings and indicate the need for nutrient control to slow the present rate of eutrophication. However, it is calculated that the present yearly load would have to be reduced by nearly 93% to just equal the eutrophic loading. Such a reduction would involve control of non-point as well as point-source phosphorus inputs.

2. Non-point sources--Non-point sources contributed 99.2% of the total phosphorus load during the sampling year. The Bighorn River contributed 64.1%, the Shoshone River contributed 32.9%, Dry Head Creek contributed 0.1%, and Crooked Creek contributed less than 0.1%. The ungaged minor tributaries and immediate drainage contributed an estimated 2.0%.

The Bighorn and Shoshone rivers had phosphorus export rates of 16 and 57 kg/km^2/year, respectively. These rates are substantially higher than the rates of the other tributaries in the

drainage basin (mean of 4 kg/km^2/year; see page 14). This may be indicative of significant inputs from the unsampled point sources noted above or non-point sources. For the Bighorn River, about 4.5% (30,360 kg/yr) of the load can be attributed to the outflow of eutrophic Boysen Reservoir*; the remaining 95.5% was contributed by runoff below the Boysen Dam and the Worland and Thermopolis wastewater treatment facilities. In a previous study, it is noted that increased flows in both rivers result in fertilization of the reservoir with enriched suspended sediment (Soltero, Wright, and Horpestad, 1973); and in another report, it is stated that agricultural practices contribute an increased silt load to the rivers from mid-April until late fall (Anonymous, 1974). Further investigation is needed to determine the controllability of such phosphorus inputs to the Bighorn and Shoshone rivers as well as the significance of the unsampled point sources.

* Working Paper No. 883.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 51.34 kilometers^2.
2. Mean depth: 26.8 meters.
3. Maximum depth: 146.3 meters.
4. Volume: 1,375.912 x 10^6 m^3.
5. Mean hydraulic retention time: 158 days (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Bighorn River	40,831.3	64.66
Shoshone River	6,086.5	29.48
Dry Head Creek	197.6	0.30
Crooked Creek	300.4	0.30
Minor tributaries & immediate drainage -	3,470.4	11.44
Totals	50,886.2	106.18

2. Outlet -

Bighorn River	50,937.5**	100.78

C. Precipitation***:

1. Year of sampling: 50.7 centimeters.
2. Mean annual: 40.3 centimeters.

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† Table of metric conversions--Appendix B.
†† Anesi, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Yellowtail Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at seven stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single 18.9-liter depth-integrated sample was composited from stations 1, 2, 3, and 4 for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4.3 meters at station 1, 14.6 meters at station 2, 35.1 meters at station 3, 50.3 meters at station 4, 62.2 meters at station 5, 51.8 meters at station 6, and 68.6 meters at station 7.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR YELLOWTAIL RESERVOIR
STORET CODE 5614

PARAMETER	1ST SAMPLING (5/21/75) 7 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/29/75) 7 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/17/75) 7 SITES RANGE	MEAN	MEDIAN
TEMP (C)	1.5 - 14.2	7.9	7.9	18.9 - 22.2	21.0	21.3	8.9 - 17.4	15.7	16.5
DISS OXY (MG/L)	5.6 - 11.6	9.4	9.2	5.0 - 8.8	6.4	6.4	5.4 - 8.8	7.4	7.4
CNDCTVY (MICROMO)	369. - 776.	570.	540.	433. - 759.	562.	534.	450. - 741.	558.	561.
PH (STAND UNITS)	7.7 - 8.5	8.1	8.0	7.8 - 8.7	8.2	8.2	7.8 - 8.4	8.2	8.2
TOT ALK (MG/L)	123. - 196.	163.	173.	107. - 169.	130.	124.	124. - 186.	139.	138.
TOT P (MG/L)	0.012 - 0.950	0.88	0.041	0.018 - 0.089	0.034	0.028	0.018 - 0.051	0.025	0.022
ORTHO P (MG/L)	0.006 - 0.045	0.023	0.020	0.004 - 0.027	0.015	0.014	0.008 - 0.031	0.017	0.017
NO2+NO3 (MG/L)	0.220 - 0.720	0.430	0.430	0.080 - 0.830	0.220	0.200	0.240 - 0.580	0.285	0.260
AMMONIA (MG/L)	0.020 - 0.090	0.058	0.060	0.020 - 0.080	0.026	0.020	0.020 - 0.060	0.027	0.020
KJEL N (MG/L)	0.201 - 1.200	0.319	0.300	0.200 - 0.500	0.241	0.200	0.200 - 0.400	0.205	0.200
INORG N (MG/L)	0.240 - 0.810	0.488	0.490	0.100 - 0.850	0.245	0.240	0.260 - 0.600	0.312	0.290
TOTAL N (MG/L)	0.420 - 1.720	0.749	0.740	0.320 - 1.130	0.461	0.420	0.440 - 0.780	0.491	0.460
CHLRPYL A (UG/L)	2.1 - 7.9	3.5	2.6	1.5 - 41.8	10.1	2.7	1.3 - 6.9	2.1	1.6
SECCHI (METERS)	0.2 - 5.5	1.8	1.1	0.6 - 15.2	4.0	2.3	0.3 - 6.1	4.1	6.1

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/21/75	1. *Fragilaria* sp.	357
	2. *Melosira* sp.	268
	3. *Asterionella* sp.	223
	4. *Lyngbya* sp.	134
	5. *Navicula* sp.	134
	Other genera	359
	Total	1,475
08/29/75	1. *Aphanizomenon* sp.	1,728
	2. *Skeletonema* sp.	241
	3. *Carteria* sp.	201
	4. *Microcystis* sp.	201
	5. *Chroomonas* (?) sp.	201
	Other genera	201
	Total	2,773
10/17/75	1. *Chroomonas* (?) sp.	363
	2. *Navicula* sp.	161
	3. *Synedra* sp.	81
	4. *Nitzschia* sp.	81
	5. *Oscillatoria* sp.	40
	Other genera	100
	Total	826

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
05/21/75	1	7.9
	2	2.6
	3	2.4
	4	2.9
	5	4.4
	6	2.1
	7	2.1

Sampling Date	Station Number	Chlorophyll a (µg/l)
08/29/75	1	16.9
	2	41.8
	3	2.6
	4	3.1
	5	1.5
	6	1.9
	7	2.7
10/17/75	1	3.5
	2	6.9
	3	2.2
	4	1.6
	5	1.3
	6	1.6
	7	1.6

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.330	0.6
0.050 P	0.055	0.330	12.4
0.050 P + 1.0 N	0.055	1.330	27.1
1.0 N	0.005	1.330	0.7

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Yellowtail Reservoir was moderate at the time the sample was collected (10/17/75). Also, a substantial increase in yield with the addition of phosphorus alone indicates the reservoir was phosphorus limited at that time. Note that the addition of nitrogen alone resulted in a yield not significantly greater than that of the control.

The reservoir data indicate phosphorus limitation as

well; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 15 to 1 or greater at all sampling times, with the exception of stations 4 and 5 in August (12 to 1 and 11 to 1, respectively). Phosphorus limitation is expected when N/P ratios are greater than 13/1.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Wyoming and Montana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v). Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Wyoming and Montana District Offices of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station D-1, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

The operators of the Byron, Greybull, and Lovell wastewater treatment plants provided monthly effluent samples and corresponding flow data. The Great Western Sugar Company at Lovell, which discharges untreated effluent, also provided monthly samples and corresponding flow data.

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* See Working Paper No. 175.

A. Waste Sources*:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Greybull	140	stab. pond	770.8	Bighorn River
Byron	400	stab. pond	1,412.7	Shoshone River
Lovell	2,371	stab. pond	1,514.2	Shoshone River

2. Known industrial -

Name	Type Waste	Treatment	Mean Flow (m^3/d)	Receiving Water
Great Western Sugar Co., Lovell	sugar processing	none	20,030.2	Shoshone River

* Prior, 1975.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source		kg P/yr	% of total
a.	Tributaries (non-point load) -		
	Bighorn River	671,595	64.1
	Shoshone River	345,055	32.9
	Dry Head Creek	1,195	0.1
	Crooked Creek	480	<0.1
b.	Minor tributaries & immediate drainage (non-point load) -	20,820	2.0
c.	Known municipal STP's -		
	Greybull	1,015	0.1
	Byron	1,610	0.2
	Lovell	3,430	0.3
d.	Septic tanks - Unknown	?	-
e.	Known industrial -		
	Great Western Sugar Co.	2,125	0.2
f.	Direct precipitation* -	900	0.1
	Total	1,048,225	100.0

2. Outputs -

Reservoir outlet - Bighorn River 66,965

3. Net annual P accumulation - 981,260 kg.

* See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Bighorn River	3,085,225	57.7
Shoshone River	1,880,125	35.2
Dry Head Creek	13,670	0.3
Crooked Creek	8,855	0.2
b. Minor tributaries & immediate drainage (non-point load) -	239,460	4.4
c. Known municipal STP's -		
Greybull	2,335	<0.1
Byron	4,940	0.1
Lovell	8,560	0.2
d. Septic tanks - Unknown	?	-
e. Known industrial -		
Great Western Sugar Co.	48,840	0.9
f. Direct precipitation* -	55,425	1.0
Total	5,347,435	100.0

2. Outputs -

Reservoir outlet - Bighorn River 5,064,620

3. Net annual N accumulation - 282,815 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Bighorn River	16	76
Shoshone River	57	309
Dry Head Creek	6	69
Crooked Creek	2	29

* See Working Paper No. 175.

E. Mean Nutrient Concentrations in Ungaged Stream:

Tributary	Mean Total P (Conc. (mg/l)	Mean Total N Conc. (mg/l)
Crooked Creek	0.100	1.108

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	20.42	19.11	104.2	5.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Yellowtail Reservoir:

"Dangerous" (eutrophic loading)	1.48
"Permissible" (oligotrophic loading)	0.74

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
5601	BIG SANDY RESERVOIR	0.087	0.060	487.667	4.383	8.800	0.020
5602	BOULDER LAKE	0.008	0.040	361.800	2.483	8.400	0.002
5603	BOYSEN RESERVOIR	0.037	0.140	465.923	6.264	14.400	0.014
5604	LAKE DE SMET	0.033	0.040	409.000	11.167	9.400	0.006
5605	FLAMING GORGE RESERVOIR	0.014	0.605	366.461	5.611	12.200	0.003
5606	FREMONT LAKE	0.006	0.040	-22.000	3.783	7.400	0.002
5607	GLENDO RESERVOIR	0.045	0.315	459.182	8.473	12.600	0.014
5608	KEY HOLE RESERVOIR	0.028	0.050	454.583	7.792	14.000	0.004
5609	OCEAN LAKE	0.043	0.040	478.333	7.500	8.600	0.004
5610	SEMINOLE RESERVOIR	0.030	0.130	447.000	2.536	11.000	0.007
5611	SODA LAKE	0.063	0.040	387.500	5.575	15.000	0.014
5612	VIVA NAUGHTON RESERVOIR	0.065	0.120	430.000	25.067	13.200	0.024
5613	WOODRUFF NARROWS RESERVO	0.069	0.105	470.000	12.950	13.200	0.019
5614	YELLOWTAIL RESERVOIR	0.026	0.310	364.500	5.410	10.000	0.017

APPENDICES

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
5601	BIG SANDY RESERVOIR	0 (0)	54 (7)	0 (0)	77 (10)	77 (10)	8 (1)	216
5602	BOULDER LAKE	92 (12)	92 (11)	92 (12)	100 (13)	92 (12)	92 (12)	560
5603	BOYSEN RESERVOIR	46 (6)	23 (3)	23 (3)	46 (6)	8 (1)	42 (5)	188
5604	LAKE DE SMET	54 (7)	73 (9)	62 (8)	15 (2)	69 (9)	62 (8)	335
5605	FLAMING GORGE RESERVOIR	85 (11)	0 (0)	77 (10)	54 (7)	46 (6)	85 (11)	347
5606	FREMONT LAKE	100 (13)	73 (9)	100 (13)	85 (11)	100 (13)	100 (13)	558
5607	GLENDO RESERVOIR	31 (4)	8 (1)	31 (4)	23 (3)	38 (5)	42 (5)	173
5608	KEY HOLE RESERVOIR	69 (9)	62 (8)	38 (5)	31 (4)	15 (2)	69 (9)	284
5609	OCEAN LAKE	38 (5)	92 (11)	8 (1)	38 (5)	85 (11)	77 (10)	338
5610	SEMINOLE RESERVOIR	62 (8)	31 (4)	46 (6)	92 (12)	54 (7)	54 (7)	339
5611	SODA LAKE	23 (3)	92 (11)	69 (9)	62 (8)	0 (0)	31 (4)	277
5612	VIVA NAUGHTON RESERVOIR	15 (2)	38 (5)	54 (7)	0 (0)	27 (3)	0 (0)	134
5613	WOODRUFF NARROWS RESERVO	8 (1)	46 (6)	15 (2)	8 (1)	27 (3)	15 (2)	119
5614	YELLOWTAIL RESERVOIR	77 (10)	15 (2)	85 (11)	69 (9)	62 (8)	23 (3)	331

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	5602	BOULDER LAKE	560
2	5606	FREMONT LAKE	558
3	5605	FLAMING GORGE RESERVOIR	347
4	5610	SEMINOLE RESERVOIR	339
5	5609	OCEAN LAKE	338
6	5604	LAKE DE SMET	335
7	5614	YELLOWTAIL RESERVOIR	331
8	5608	KEY HOLE RESERVOIR	284
9	5611	SODA LAKE	277
10	5601	BIG SANDY RESERVOIR	216
11	5603	BOYSEN RESERVOIR	188
12	5607	GLENDO RESERVOIR	173
13	5612	VIVA NAUGHTON RESERVOIR	134
14	5613	WOODRUFF NARROWS RESERVO	119

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR WYOMING 08/05/76

LAKE CODE 5614 YELLOWTAIL RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 50937.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
5614A1	50937.5	64.85	67.39	78.72	77.59	122.05	249.47	169.62	73.34	75.32	82.40	77.59	70.23	100.78
5614A2	40831.3	36.25	41.82	53.32	52.33	96.59	186.61	94.21	39.50	41.74	48.90	46.21	38.45	64.66
5614B1	6086.5	22.91	23.98	25.91	26.56	20.93	50.81	55.90	21.89	25.94	28.37	26.28	24.92	29.48
5614D1	197.6	0.18	0.18	0.23	0.28	0.40	0.82	0.40	0.25	0.23	0.25	0.23	0.20	0.30
5614E1	300.4	0.23	0.23	0.23	0.17	0.42	0.91	0.37	0.17	0.20	0.23	0.28	0.23	0.30
5614ZZ	3522.4	3.68	4.25	4.25	7.65	22.94	33.98	15.86	11.89	13.03	9.91	5.66	3.96	11.44

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 50937.5
SUM OF SUB-DRAINAGE AREAS = 50938.3
TOTAL FLOW IN = 1273.88
TOTAL FLOW OUT = 1208.56

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
5614A1	10	74	101.374	5	72.491				
	11	74	103.073	2	38.511				
	12	74	107.887	7	109.869				
	1	75	107.887						
	2	75	102.224	1	108.737	22	91.747		
	3	75	90.897						
	4	75	94.861	5	85.800				
	5	75	148.663	17	152.345				
	6	75	193.404						
	7	75	216.624	19	223.703				
	8	75	146.964	2	180.945				
	9	75	111.002						
5614A2	10	74	50.517	5	49.271				
	11	74	50.319	10	49.838				
	12	74	54.991	6	49.838				
	1	75	48.450						
	2	75	47.119						
	3	75	57.228						
	4	75	58.899	10	60.881				
	5	75	103.696	1	59.182	23	149.796		
	6	75	174.658	17	179.529				
	7	75	202.522	7	251.454	28	137.337		
	8	75	59.975	7	63.147				
	9	75	40.946	10	41.909				

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TRIBUTARY FLOW INFORMATION FOR WYOMING 08/05/76

LAKE CODE 5614 YELLOWTAIL RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
561481	10	74	26.108	5	26.731				
	11	74	20.586	10	20.275				
	12	74	17.556	6	18.094				
	1	75	17.585	4	18.123				
	2	75	16.877						
	3	75	16.792	7	15.518				
	4	75	25.570	10	22.144				
	5	75	54.057	2	39.360	23	71.925		
	6	75	44.542	17	37.661				
	7	75	103.356	7	111.852	28	47.855		
	8	75	28.827	7	27.496				
	9	75	23.560	10	22.144				
5614D1	10	74	0.255						
	11	74	0.227	2	0.198				
	12	74	0.198	6	0.198				
	1	75	0.184						
	2	75	0.184						
	3	75	0.212						
	4	75	0.255						
	5	75	0.368	17	0.566				
	6	75	1.671						
	7	75	2.350	7	0.425				
	8	75	0.396	2	0.340				
	9	75	0.340						
5614E1	10	74	0.198	5	0.198				
	11	74	0.198	10	0.198				
	12	74	0.283	6	0.368				
	1	75	0.283	4	0.283				
	2	75	0.283	4	0.283				
	3	75	0.283	7	0.283				
	4	75	0.566	10	0.255				
	5	75	2.832	2	4.814	18	2.832	23	1.416
	6	75	2.549	17	3.398				
	7	75	1.416	7	2.832	28	0.453		
	8	75	0.708	7	0.765				
	9	75	0.708	10	0.736				
5614ZZ	10	74	8.778						
	11	74	3.964						
	12	74	4.814						
	1	75	4.531						
	2	75	5.380						
	3	75	5.380						
	4	75	6.796						
	5	75	33.980						
	6	75	31.149						
	7	75	16.990						
	8	75	8.778						
	9	75	8.778						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/05

561401
44 52 57.0 108 10 53.0 3
YELLOWTAIL RESERVOIR
56003 WYOMING

090291

11EPALES 2111202
0007 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/21	14 40	0000	7.8	9.0		384	7.70	131	0.050	0.500	0.430	0.018
75/08/29	08 10	0000	19.3	8.8	24	739	8.70	162	0.020K	0.300	0.230	0.004
	08 10	0005	19.3	8.8		739	8.70	164	0.020K	0.300	0.220	0.006
	08 10	0014	18.9	6.6		759	8.65	167	0.020K	0.200	0.300	0.004
75/10/17												
	17 05	0000	10.3	7.8	12	691	8.40	137	0.040	0.200	0.250	0.020
	17 05	0005	8.9	8.0		676	8.30	186	0.030	0.200	0.440	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/21	14 40	0000		7.9	
75/08/29	08 10	0000	0.048	16.9	
	08 10	0005	0.047		
	08 10	0014	0.085		
75/10/17					
	17 05	0000	0.034	3.5	
	17 05	0005	0.041		

K VALUE KNOWN TO BE
LESS THAN INDICATED

ADMINISTRATIVE AND CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/05

561402
44 57 17.0 108 15 32.0 3
YELLOWTAIL RESERVOIR
56003 WYOMING
090291

11EPALES 2111202
0024 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	11 00	0000	8.1	8.8	9	413	8.00	125	0.090	0.600	0.460	0.039
	11 00	0005	7.9	8.6		419	8.00	123	0.080	0.500	0.470	0.030
	11 00	0015	7.7	8.8		417	8.00	125	0.090	0.600	0.510	0.036
	11 00	0020	7.6	8.6		553	8.00	127	0.090	1.200	0.520	0.045
	16 45	0005						175	0.020	0.200K	0.330	0.012
75/08/29	08 40	0000	20.2	8.0	24	725	8.65	157	0.020	0.300	0.830	0.007
	08 40	0005	20.2	7.8		725	8.50	158	0.020	0.400	0.080	0.006
	03 40	0015	20.1	7.6		727	8.60	161	0.020	0.500	0.080	0.007
	08 40	0048	19.0	6.4		729	8.45	168	0.080	0.300	0.180	0.012
75/10/17	16 45	0000	15.9	8.8	84	525	8.30	133	0.040	0.400	0.250	0.017
	16 45	0005	15.0	8.4		531	8.40	136	0.040	0.200	0.260	0.017
	16 45	0015	12.6	8.4		591	8.35	157	0.060	0.200	0.260	0.014
	16 45	0020	12.4	8.4		600	8.40	135	0.040	0.200	0.250	0.017

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/22	11 00	0000	0.173	2.6	
	11 00	0005	0.228		
	11 00	0015	0.248		
	11 00	0020	0.950		
	16 45	0005	0.228		
75/08/29	08 40	0000	0.061	41.8	
	08 40	0005	0.063		
	08 40	0015	0.058		
	08 40	0048	0.089		
75/10/17	16 45	0000	0.043	6.9	
	16 45	0005	0.037		
	16 45	0015	0.026		
	16 45	0020	0.029		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

561403
45 01 21.0 108 14 49.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 751126 2111202
0083 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	11 30	0000	12.6	10.4	13	503	8.00	141	0.080	0.500	0.450	0.026
	11 30	0005	11.9	8.3		489	8.00	138	0.070	0.400	0.440	0.035
	11 30	0015	9.2	9.1		404	8.00	130	0.060	0.400	0.400	0.031
	11 30	0030	8.4	9.4		400	8.00	126	0.060	0.300	0.390	0.044
	11 30	0050	7.9	9.4		402	8.00	126	0.060	0.400	0.430	0.027
	11 30	0080	7.8	9.2		398	8.30	126	0.070	0.400	0.420	0.042
75/08/29	09 00	0000	21.2	6.4	66	569	8.40	132	0.020	0.300	0.180	0.015
	09 00	0005	21.2	6.2		557	8.30	132	0.020	0.200	0.180	0.015
	09 00	0015	21.2	6.6		565	8.30	135	0.020	0.200K	0.180	0.015
	09 00	0060	21.0	6.4		585	8.30	137	0.020	0.200	0.180	0.013
	09 00	0080	19.9	6.2		691	8.40	161	0.070	0.400	0.140	0.011
	09 00	0115	19.7	6.2		725	8.40	169	0.080	0.400	0.150	0.012
75/10/17	16 15	0000	16.5	8.1	120	495	8.20	125	0.040	0.200K	0.240	0.013
	16 15	0005	16.2	8.0		504	8.25	128	0.020K	0.200K	0.250	0.016
	16 15	0015	16.1	7.8		581	8.30	127	0.020K	0.200K	0.240	0.016
	16 15	0035	16.1	7.8		589	8.25	125	0.040	0.200K	0.250	0.016
	16 15	0060	14.9	8.1		622	8.30	164	0.020K	0.200	0.260	0.016
	16 15	0108	11.9	8.0		741	8.30	125	0.020K	0.200K	0.240	0.016

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/22	11 30	0000	0.081	2.4	
	11 30	0005	0.076		
	11 30	0015	0.082		
	11 30	0030	0.090		
	11 30	0050	0.136		
	11 30	0080	0.141		
75/08/29	09 00	0000	0.029	2.6	
	09 00	0005	0.028		
	09 00	0015	0.033		
	09 00	0060	0.028		
	09 00	0080	0.038		
	09 00	0115	0.059		
75/10/17	16 15	0000	0.026	2.2	
	16 15	0005	0.019		
	16 15	0015	0.022		
	16 15	0035	0.023		
	16 15	0060	0.029		
	16 15	0108	0.027		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

561404
45 06 49.0 108 11 00.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 751126 2111202
0165 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	12 00	0000	14.2	9.4	24	776	8.10	159	0.060	0.300	0.440	0.034
	12 00	0005	14.2	7.8		776	8.00	159	0.070	0.200	0.440	0.036
	12 00	0015	14.2	7.7		773	8.00	159	0.070	0.300	0.440	0.035
	12 00	0030	14.1	7.8		767	7.80	159	0.070	0.300	0.450	0.027
	12 00	0050	12.7	7.6		748	7.80	158	0.070	0.300	0.470	0.033
	12 00	0070	9.4	7.6		759	8.20	163	0.080	0.300	0.590	0.026
	12 00	0100	6.3	8.4		740	7.90	176	0.080	0.300	0.530	0.020
	12 00	0130	5.8	8.8		724	8.30	177	0.080	0.300	0.520	0.018
	12 00	0160	5.7	8.6		732	8.00	176	0.090	0.300	0.520	0.031
75/08/29	14 20	0000	22.2	6.4	90	539	8.15	124	0.020K	0.200	0.200	0.021
	14 20	0005	21.9	6.4			8.30	124	0.020K	0.200	0.180	0.020
	14 20	0016	21.5	6.2		531	8.30	125	0.020K	0.200	0.190	0.019
	14 20	0035	21.5	6.6		536	8.20	122	0.020K	0.200	0.200	0.019
	14 20	0065	21.5	6.3		537	8.20	124	0.020K	0.200K	0.200	0.018
	14 20	0100	21.2	6.0		622	8.25	141	0.020	0.200	0.180	0.015
	14 20	0134	20.7	5.8		665	8.30	151	0.080	0.200	0.120	0.013
75/10/17	12 15	0000	16.6	8.5	240	501	8.25	129	0.020K	0.200K	0.260	0.016
	12 15	0005	16.6	8.2		502	8.20	126	0.030	0.200K	0.260	0.016
	12 15	0023	16.6	7.4		502	8.20	126	0.020	0.200K	0.260	0.016
	12 15	0055	16.6	7.8		503	8.20	124	0.020K	0.200K	0.260	0.016
	12 15	0105	16.4	7.4		515	8.30	150	0.050	0.200K	0.260	0.014
	12 15	0135	13.9	8.0		606	8.30	151	0.060	0.200K	0.260	0.014
	12 15	0165	13.8	7.8		607	8.25	151	0.060	0.200	0.260	0.014

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

561404
45 06 49.0 108 11 00.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 751126 2111202
0165 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/22	12 00	0000	0.056	2.9	
	12 00	0005	0.054		
	12 00	0015	0.075		
	12 00	0030	0.055		
	12 00	0050	0.065		
	12 00	0070	0.052		
	12 00	0100	0.051		
	12 00	0130	0.092		
	12 00	0160	0.370		
75/08/29	14 20	0000	0.026	3.1	
	14 20	0005	0.028		
	14 20	0016	0.024		
	14 20	0035	0.035		
	14 20	0065	0.033		
	14 20	0100	0.028		
	14 20	0134	0.039		
75/10/17	12 15	0000	0.026	1.6	
	12 15	0005	0.025		
	12 15	0023	0.021		
	12 15	0055	0.020		
	12 15	0105	0.022		
	12 15	0135	0.026		
	12 15	0165	0.027		

561405
45 14 02.0 108 04 38.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0999 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	12	45 0000	11.6		60	718	8.10	170	0.040	0.300	0.480	0.021
	12	45 0005	11.7	8.6		704	8.10	170	0.030	0.200	0.470	0.020
	12	45 0018	11.4	9.0		702	8.10	170	0.030	0.200	0.460	0.020
	12	45 0030	11.3	9.2		690	8.10	173	0.050	0.300	0.430	0.019
	12	45 0050	8.3	9.2		625	8.10	186	0.060	0.200K	0.350	0.019
	12	45 0075	6.3	8.0		608	8.00	184	0.080	0.200	0.410	0.020
	12	45 0110	4.8	9.6		579	7.90	176	0.070	0.200K	0.450	0.017
	12	45 0155	5.1	7.8		606	7.90	174	0.090	0.200	0.560	0.027
	12	45 0204	5.8	5.6		670	7.90	175	0.090	0.200	0.720	0.028
75/08/29	13	35 0000	21.5	6.0	120	461	8.00	108	0.020	0.200K	0.220	0.020
	13	35 0005	21.4	6.0		463	8.00	107	0.020K	0.200K	0.220	0.025
	13	35 0020	21.4	6.0		459	7.90	109	0.020K	0.200K	0.220	0.022
	13	35 0050	21.3	6.0		461	7.90	111	0.020K	0.200	0.220	0.022
	13	35 0085	21.3	6.2		457	7.80	113	0.020K	0.200	0.220	0.022
	13	35 0125	21.3	5.0		553	7.90	136	0.020K	0.300	0.240	0.026
	13	35 0170	20.8	5.0		651	8.00	153	0.020K	0.300	0.270	0.022
75/10/17	12	30 0000	16.6	7.4	240	515	8.25	126	0.020K	0.200K	0.270	0.017
	12	30 0005	16.6	7.6		550	8.25	128	0.020	0.200K	0.270	0.017
	12	30 0023	16.6	7.4		560	8.20	130	0.020K	0.200K	0.260	0.017
	12	30 0050	16.6	7.6		560	8.20	129	0.020K	0.200K	0.260	0.017
	12	30 0090	16.6	7.2		560	8.20	130	0.020K	0.200K	0.260	0.017
	12	30 0130	16.5	7.4		560	8.20	139	0.020K	0.200	0.300	0.020
	12	30 0170	15.9	6.8		602	8.20	145	0.020	0.200K	0.310	0.017
	12	30 0200	15.7	6.6		568	8.20	148	0.020K	0.200	0.320	0.016

K VALUE KNOWN TO BE
LESS THAN INDICATED

32

STORET RETRIEVAL DATE 76/08/05

561405
45 14 02.0 108 04 38.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0999 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/22	12 45	0000	0.043	4.4	
	12 45	0005	0.041		
	12 45	0018	0.036		
	12 45	0030	0.036		
	12 45	0050	0.033		
	12 45	0075	0.024		
	12 45	0110	0.026		
	12 45	0155	0.047		
	12 45	0204	0.116		
75/08/29	13 35	0000	0.025	1.5	
	13 35	0005	0.026		
	13 35	0020	0.024		
	13 35	0050	0.024		
	13 35	0085	0.023		
	13 35	0125	0.029		
	13 35	0170	0.033		
75/10/17	12 30	0000	0.020	1.3	
	12 30	0005	0.020		
	12 30	0023	0.018		
	12 30	0050	0.018		
	12 30	0090	0.020		
	12 30	0130	0.021		
	12 30	0170	0.021		
	12 30	0200	0.051		

STORET RETRIEVAL DATE 76/08/05

561406
45 16 27.0 107 59 57.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0160 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	16	00 0000	8.3	10.6	96	369	8.40	167	0.020	0.200K	0.220	0.013
	16	00 0005	8.5	11.2		422	8.20	170	0.030	0.200K	0.250	0.015
	16	00 0015	9.0	10.8		500	8.10	173	0.020	0.200K	0.300	0.014
	16	00 0028	8.8	11.6		540	8.40	176	0.030	0.200K	0.330	0.013
	16	00 0050	5.3	10.8		528	8.00	177	0.040	0.200K	0.370	0.013
	16	00 0090	3.2	10.6		508	8.00	177	0.040	0.200K	0.400	0.013
	16	00 0130	2.7	10.2		522	7.90	180	0.050	0.200	0.430	0.016
	16	00 0155	2.8	10.2		529	7.90	180	0.060	0.300	0.430	0.015
75/08/29	13	10 0000	21.9	7.0	192	469	8.10	110	0.020K	0.200	0.200	0.014
	13	10 0005	21.7	6.4		467	8.10	111	0.020K	0.200	0.200	0.014
	13	10 0022	21.6	6.2		463	8.10	112	0.020K	0.200	0.200	0.013
	13	10 0050	21.6	6.4		465	8.10	112	0.020K	0.200	0.200	0.013
	13	10 0085	21.6	5.8		463	8.05	112	0.020K	0.200	0.220	0.015
	13	10 0125	21.2	5.2		459	8.00	110	0.020K	0.300	0.260	0.019
	13	10 0170	20.4	6.2		433	8.15	117	0.020	0.200	0.180	0.011
75/10/17	11	50 0000	17.0	7.0	240	481	8.20	136	0.020K	0.200K	0.260	0.018
	11	50 0005	17.0	7.0		485	8.20	138	0.020K	0.200K	0.260	0.017
	11	50 0023	17.0	7.0		484	8.20	137	0.020K	0.200K	0.260	0.016
	11	50 0050	16.9	6.8		482	8.20	139	0.020K	0.200K	0.260	0.016
	11	50 0100	16.9	7.4		485	8.15	139	0.020K	0.200K	0.260	0.016
	11	50 0135	16.2	7.4		450	8.20	138	0.020K	0.200K	0.250	0.016
	11	50 0162	16.4	5.8		621	8.00	145	0.020K	0.200K	0.370	0.021

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

561406
45 16 27.0 107 59 57.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0160 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/22	16 00	0000	0.018	2.1	
	16 00	0005	0.020		
	16 00	0015	0.023		
	16 00	0028	0.019		
	16 00	0050	0.016		
	16 00	0090	0.016		
	16 00	0130	0.017		
	16 00	0155	0.018		
75/08/29	13 10	0000	0.024	1.9	
	13 10	0005	0.023		
	13 10	0022	0.022		
	13 10	0050	0.022		
	13 10	0085	0.023		
	13 10	0125	0.022		
	13 10	0170	0.020		
75/10/17	11 50	0000	0.019	1.6	
	11 50	0005	0.018		
	11 50	0023	0.019		
	11 50	0050	0.019		
	11 50	0100	0.018		
	11 50	0135	0.018		
	11 50	0162	0.023		

35

STORET RETRIEVAL DATE 76/08/05

561407
45 18 16.0 107 57 31.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0999 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/22	16	45 0000	9.6	10.8	216	542	8.20	175	0.020	0.300	0.330	0.014
	16	45 0005	9.1	11.6		540	8.20	175	0.020	0.200K	0.330	0.012
	16	45 0020	7.4	11.4		540	8.50	175	0.020	0.200	0.330	0.012
	16	45 0041	2.6	11.6		540	8.50	176	0.030	0.300	0.360	0.010
	16	45 0070	4.4	11.0		520	8.00	176	0.030	0.600	0.380	0.006
	16	45 0110	3.0	10.6		518	8.00	178	0.050	0.200	0.410	0.011
	16	45 0150	3.1	10.4		536	7.90	182	0.070	0.300	0.430	0.011
	16	45 0185	2.6	9.6		566	8.20	188	0.080	0.300	0.440	0.018
	16	45 0220	1.5	9.2		519	8.00	196	0.090	0.300	0.480	0.020
75/08/29	12	50 0000	22.1	6.6	600	511	8.20	113	0.020	0.200K	0.220	0.013
	12	50 0005	21.9	6.6		507	8.20	115	0.020	0.200	0.220	0.013
	12	50 0022	21.8	6.6		505	8.20	116	0.020	0.200K	0.220	0.011
	12	50 0050	21.8	6.6		511	8.25	117	0.020	0.200K	0.230	0.011
	12	50 0085	21.8	6.7		507	8.20	117	0.020	0.200	0.230	0.011
	12	50 0120	21.2	5.4		478	8.05	112	0.020K	0.200K	0.300	0.022
	12	50 0170	20.6	5.0		469	8.00	115	0.020K	0.200	0.310	0.027
75/10/17	11	15 0000	17.4	7.4	240	561	8.10	138	0.020K	0.200	0.300	0.019
	11	15 0005	17.4	6.8		561	8.20	141	0.020K	0.200K	0.290	0.018
	11	15 0021	17.4	6.6		562	8.10	142	0.020K	0.200K	0.300	0.018
	11	15 0050	17.4	6.8		562	8.15	142	0.020K	0.200	0.290	0.018
	11	15 0090	17.4	7.0		563	8.10	143	0.020K	0.200K	0.290	0.018
	11	15 0130	17.3	6.7		561	8.10	145	0.020K	0.200K	0.300	0.018
	11	15 0170	16.4	6.0		638	7.80	161	0.020K	0.200K	0.580	0.031
	11	15 0225	13.6	5.4		587	7.85	156	0.020K	0.200K	0.480	0.027

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

S61407
45 18 16.0 107 57 31.0 3
YELLOWTAIL RESERVOIR
30003 WYOMING

11EPALES 760114 2111202
0999 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCOT LT REMNING PERCENT
75/05/22	16 45	0000	0.014	2.1	
	16 45	0005	0.038		
	16 45	0020	0.021		
	16 45	0041	0.017		
	16 45	0070	0.016		
	16 45	0110	0.012		
	16 45	0150	0.018		
	16 45	0185	0.021		
	16 45	0220	0.021		
75/08/29	12 50	0000	0.028	2.7	
	12 50	0005	0.021		
	12 50	0022	0.019		
	12 50	0050	0.018		
	12 50	0085	0.019		
	12 50	0120	0.030		
	12 50	0170	0.036		
75/10/17	11 15	0000	0.025	1.6	
	11 15	0005	0.023		
	11 15	0021	0.021		
	11 15	0050	0.019		
	11 15	0090	0.021		
	11 15	0130	0.021		
	11 15	0170	0.030		
	11 15	0225	0.041		

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/05

5614A1
45 18 25.0 107 57 30.0 4
BIG HORN RIVER
56 7.5 YELOTAIL DAM
O/YELLOWTAIL RESERVOIR 090291
BELO DAM 1.5 MI FRM FORT SMITH
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/05	12 50		0.384	1.900	0.030	0.015	0.022
74/12/07	15 00		0.430	1.600	0.035	0.015	0.030
75/02/01	10 50		0.392	2.200	0.368	0.016	0.024
75/02/22	11 20		0.432	0.400	0.040	0.016	0.016
75/04/05	12 00		0.440	1.000	0.040	0.010	0.010
75/05/17	11 00		0.450	0.450	0.065	0.010	0.010
75/07/19	21 00		0.345	1.400	0.055	0.020	0.025
75/08/02	15 30		0.350	0.600	0.010	0.020	0.030

APPENDIX E
RETAINED FOR LIBRARY REFERENCE
DATA FROM PLANT TREATMENT

STORET RETRIEVAL DATE 76/08/05

5614A2
44 45 31.0 108 10 51.0 4
BIG HORN RIVER
56 7.5 KANE
T/YELLOWTAIL RESERVOIR 090291
GAGING STATN .4 MI W OF DIRT RD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/05	09 00		0.256	1.500	0.030	0.005K	0.060
74/11/10	12 00		0.224	0.900	0.040	0.005	0.090
74/12/06	10 30		0.296	0.950	0.030	0.005K	0.050
75/04/10	13 00		0.430	1.900	0.040	0.040	0.930
75/05/01	14 30		0.280	1.650	0.020	0.035	0.440
75/05/23	14 30		0.730		0.035	0.040	
75/06/17	14 00		0.220	1.850	0.410	0.032	0.480
75/07/07	09 30		0.180	1.000	0.030	0.025	0.560
75/07/28	09 30		0.260	0.850	0.050	0.030	0.290
75/08/07	14 00		0.320	0.825	0.020	0.025	0.280
75/09/10	10 00		0.135	1.100	0.025	0.005	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/04/05

561481
44 51 30.0 108 19 50.0 4
SHOSHONE RIVER
56 7.5 LOVELL LAKES
T/YELLOWTAIL RESERVOIR 090291
BRDG .3 MI N OF XING @ CMI.BUR.QY RR
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/10/05	10 00		0.750	1.400	0.045	0.087	0.185
74/11/10	12 30		0.930	0.900	0.055	0.015	0.070
74/12/06	11 00		0.940	1.500	0.075	0.015	0.140
75/01/04	12 30		0.820	0.500	0.104	0.025	0.085
75/03/07	14 00		0.680	0.950	0.110	0.050	0.240
75/04/10	15 30		0.580	2.000	0.060	0.030	0.377
75/05/02	14 30		0.280	2.000	0.030	0.035	0.880
75/05/23	15 30		0.420	2.100	0.030	0.030	1.250
75/06/17	15 30		0.690	0.750	0.085	0.060	0.290
75/07/07	10 45		0.375	1.450	0.095	0.055	0.857
75/07/28	10 30		0.760	1.450	0.135	0.070	0.360
75/08/07	13 15		0.920	1.050	0.025	0.060	0.360
75/09/10	11 00		0.860	2.000	0.030	0.035	0.280

STORET RETRIEVAL DATE 76/08/05

5614D1
45 13 15.0 108 09 45.0 4
DRY HEAD CREEK
56 7.5 DEAD INDN HL
T/YELLOWTAIL RESERVOIR 090291
BANK GAGE STA END DIRT RD & TRAIL
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/02	13	00	0.232	1.000	0.015	0.005K	0.010
74/12/06	11	45	0.296	0.700	0.010	0.005K	0.010K
75/05/17	13	00	0.250		0.035	0.015	
75/07/07	16	00	0.165	1.200	0.430	0.005K	0.080
75/08/02	12	05	0.190	1.400	0.020	0.005K	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

561488 N0561488 P000000
44 51 00.0 108 23 03.0 4
G.W. SUGAR CO.
56 7.5 LOVELL
T/YELLOWTAIL RESERVOIR 090291
SHOSHONE RIVER
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/03	12 45		0.480	1.400	0.080K	0.094	0.100K	5.330	5.330
75/10/23	11 30		0.025	12.000	0.025K	0.067	0.350	5.010	3.950
75/11/13	13 00		0.375	5.700	0.083	0.050	0.100K	5.700	5.700
75/12/04	08 00		0.325	6.600	0.025K	0.110	0.480	5.330	5.990
75/12/26	15 00		0.275	6.800	0.040		0.600	5.330	5.410
76/01/14	10 00		0.350	7.600	0.025K	0.050	0.250	5.330	5.330
76/02/05	13 00		0.275	4.900		0.045	0.170	5.330	5.330

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

5614E1
44 45 31.0 108 10 51.0 4
CROOKED CREEK
56 7.5 SYKES SPRING
T/YELLOWTAIL RESERVOIR 090291
BNK 200 FT DSTRM FRM MOUTH BIG COULEE RV
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	13	00	0.610	0.800	0.030	0.005K	0.025
74/12/06	11	30	0.464	0.800	0.025	0.005K	0.030
75/01/04	13	10	0.464	0.400	0.024	0.006	0.030
75/02/04	14	30	0.492	0.200	0.032	0.008	0.020
75/03/07	13	30	0.390	0.250	0.025	0.010	0.040
75/04/10	15	00	0.230	2.700	0.040	0.005K	0.050
75/05/02	14	00	0.220	0.550	0.015	0.005K	0.130
75/05/18	09	35	0.160	0.700	0.015	0.015	0.070
75/05/23	15	00	0.270	0.900	0.015	0.005	
75/06/17	15	00	0.190	0.800	0.165	0.015	0.370
75/07/07	10	30	0.210		0.045	0.005K	0.300
75/07/28	10	00	0.360	0.550	0.010	0.010	0.080
75/08/07	15	00	0.530	0.350	0.025	0.010	0.130
75/09/10	10	30	0.520	0.500	0.050	0.010	0.030

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

5614AA PD5614AA P000140
44 30 30.0 108 03 30.0 4
GREYBULL
56 7.5 GREYBULL N.
T/YELLOWTAIL RES. 090291
BIGHORN RIVER
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/03	13 00		0.080	8.000	6.800	4.400	5.600	0.220	0.220
75/03/05	08 30		0.080	15.000	6.400	2.600	5.600	0.220	0.220
75/04/07	09 00		0.020	14.000	2.200	2.400	5.400	0.200	0.210
75/04/29	09 00		0.050	14.500	3.400	2.300	5.400	0.210	0.210
75/05/19	09 15		0.200	6.250	0.600	0.860	1.250	0.210	0.210
75/06/09	09 00		0.100	4.600	0.130	2.100	2.800	0.210	0.210
75/06/23	08 30		0.050	4.200	0.025K	2.750	3.650	0.220	0.220
75/07/29	08 30		0.075	4.700	0.025K	1.150	1.420	0.220	0.220
75/08/18	11 00		0.025	6.700	0.160	2.200	2.800	0.220	0.220
75/09/08	13 30		0.026	5.300	0.160	2.050	2.500	0.100	0.100
75/09/29	08 30		0.025	6.100	0.050	2.000	2.700	0.200	0.200
75/11/03			0.100	6.100	0.160	2.300	2.700		

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/05

5614BA PD5614BA P000400
44 47 30.0 108 30 00.0 4
BYRON
56 7.5 BYRON
T/YELLOWTAIL RES. 090291
SHOSHONE RIVER
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/12	13	30	0.080	13.650	1.870	4.150	4.700	0.095	0.102
75/03/19	09	00	0.160	11.000	0.110	3.500	4.200	0.257	0.257
75/04/21	11	00	0.100	14.500	0.125	4.150	5.800	0.050	0.069
75/05/15	10	00	0.050	16.000	0.550	3.300	4.800	0.063	0.055
75/06/20	14	00	0.950	4.900	0.088	0.930	1.500	0.062	0.283
75/07/17	10	00	0.050	2.750	0.030	0.450	0.800	0.795	1.240
75/08/12	10	00	0.225	4.100	0.025K	0.400	0.620	0.707	0.750
75/09/17	09	00	0.075	4.700	0.025K	0.740	1.000	0.659	0.617
75/10/16	10	00	0.225	26.000	0.025K	0.835	10.000	0.573	0.531
75/11/17	16	30	0.175	7.200	0.025K	1.570	2.250	0.200	0.365
75/12/15	09	30	0.050	9.100	1.800	2.500	3.200	0.163	0.181
76/01/13	10	00	0.025	16.000	6.100	2.600	4.500	0.169	0.166
76/02/17	13	00	0.050	14.000	4.300	2.000	5.100	0.209	0.236

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 76/06/05

56148C PDS6148C P002371
44 51 00.0 108 23 00.0 4
LOVELL
56 7.5 LOVELL
T/YELLOWTAIL RES. 090291
SHOSHONE RIVER
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/05	08 30		0.080	16.000	15.200	6.900	8.400	0.400	0.400
75/03/04	16 00		0.036	16.000	6.400	4.800	6.000	0.400	0.400
75/04/01	08 30		0.020	23.000	12.000	1.820	9.100	0.400	0.400
75/04/25	09 00		0.100	28.000	10.500		10.000	0.400	0.400
75/05/23	10 30		0.050	26.000	6.400	6.400	9.700	0.400	0.400
75/06/09	08 30		0.050	19.500	6.000	4.100	8.500	0.400	0.400
75/07/01	10 00		0.479	13.500	0.150	3.900	5.100	0.400	0.400
75/07/31	15 00		0.125	13.000	0.110	3.300	3.700	0.400	0.400
75/08/21	10 30		0.150	8.400	0.025K	1.900	2.500	0.400	0.400
75/09/05	09 00		0.050	11.000	0.180	2.200	3.100	0.400	0.400
75/10/02	15 00		0.025	6.500	0.050			0.473	0.400
75/10/10	08 30		0.100	6.600	0.250	1.880	2.500	0.400	0.400
75/11/10	09 00		0.100	9.500	0.063	4.800	6.100	0.400	0.400
75/12/16	08 30		0.025	20.000	4.600	5.800	6.000	0.400	0.400